PATENT SPECIFICATION

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737,198

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COMPLETE SPECIFICATION

Pressure Reducing Valve

We, DUNLOP RUBBER COMPANY LIMITED, a British Company, of 1, Albany Street, London, N.W.1, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to fluid pressure reducing valves.

In the majority of known pressure reducing devices the pressure fluid exerts a substantial force on the associated inlet valve tending to hold it open and it is necessary to provide means to compensate for this force so that the device may be sensitive to fluctuations in the pressure on the low pressure side.

It is an object of the invention to provide an improved pressure reducing device in which no substantial axial force is exerted by the pressure fluid tending to hold the movable portion of the device open and compensating means are therefore not required.

It is a further object of the invention to provide a pressure reducing device which incorporates an automatic relief valve of novel construction.

According to the invention a fluid pressure reducing device comprising a housing containing an operating chamber adapted to be connected at one end to a source of fluid pressure and at the other end to an apparatus to be operated and a relief chamber connected to exhaust, a rockably mounted inlet valve seat in the operating chamber, a tubular inlet valve slidable in a sleeve forming part of the operating chamber and spring urged towards the inlet valve seat, a relief valve seat carried by the tubular inlet valve at the end thereof remote from the inlet valve seat and a relief valve integral with a piston fluid-tightly slidable within the relief chamber, said relief valve being exposed on one face to the fluid pressure in the operating chamber and being spring loaded on the other face into engagement with the relief valve seat to close said valve and open the inlet valve whereby pressure fluid entering the inlet nozzle flows through the inlet valve and the operating chamber to the outlet nozzle and thence to the apparatus to be operated.

In a preferred form of the invention the pressure reducing device contains a tubular inlet valve which has no axial forces acting upon it tending to open it when it is seated and an inlet valve seat which is self-aligning. The piston is annular and surrounds an intermediate portion of the tubular inlet valve, one face of the piston forming the relief valve and the other face of the piston providing means for locating a return spring. A cylindrical sleeve extends axially inwardly from the inlet end of the housing and serves as a guide for the inlet valve.

The invention will now be more fully described with reference to the accompanying drawing which is a sectional view of a pressure reducing device constructed according to the invention.

The device comprises a cylindrical housing 1, open at one end which shall hereinafter be described as the inlet end, and having a reduced diameter portion 2 at the other end, which shall hereinafter be described as the outlet end. The reduced diameter portion 2 is formed with a frusto-conical interior 3 the smaller diameter of which is remote from said open end of the housing. A further reduced diameter portion 4 is externally threaded and adapted to form an outlet nozzle for connection to a mechanism to be operated.

A high pressure portion comprising a cylindrical sleeve 5 stepped to two diameters having a radially-extending flange 6 formed integrally with the end of the larger diameter is positioned within the housing. The bore 7 of the flanged end is greater than the bore 8 of the smaller end and a plurality of radial projections 9 extend inwardly from the larger bore.

An inlet portion 10 is screw-threaded at one end to form an inlet nozzle and is provided with a radially-extending flange 11 at the

other end. The flange 11 abuts the flange 6 of the high pressure portion and the two flanges are held tightly together and rigidly in contact with the open end of the housing 1 by means of a ring nut 12 screwed onto a threaded portion of the outer periphery of the housing. A plurality of passages 13 inclined to the longitudinal axis of the inlet nozzle extend from the nozzle to the larger bore 7 of the high pressure portion. A rockable and removable metal inlet valve seat 14 of conical shape has a short stem 15 extending into a recess 16 formed between the passages 13 of the inlet portion 10, and a flat face 17 located adjacent the radial projections 9 said face being spaced a short distance from the ends of said projections to provide a clearance therebetween so that the valve seat 14 can rock slightly relative thereto.

A tubular inlet valve 18 is slidable through the smaller bore 8 of the sleeve 5 and has one end chamfered to a knife-edge 19 adapted to seat on the flat face 17 of the metal inlet valve seat 14. The valve 18 has a tubular shank 18*a* which extends axially through the housing to form an annular relief chamfer 20 between the inner periphery of the housing 1 and the outer periphery of the tubular shank. A radially-extending flange 21 is formed integrally with the end of the valve shank 18*a* remote from the chamfered end 19 and is normally positioned within the frusto-conical cavity 3 in the housing. A relief valve seating ring 22 of silicone rubber is secured within an annular groove formed in the side of the valve flange 21 remote from the outlet nozzle 4. The bore of the valve flange 21 is countersunk to a depth approximately equal to half the thickness of the flange to form an annular radially-extending step 23 and a helical inlet valve spring 24 is interposed between the step 23 and an inwardly-projecting abutment 25 formed within the outlet nozzle 4. An annular piston 26 provided with a metal sealing ring 27 and having a cylindrical skirt 28 is fluid-tightly slidable within the housing 1 and is urged into contact with the end wall of the housing by means of a helical return spring 29 positioned between the flange 6 of the high pressure portion and the face of the piston 26 adjacent the skirt 28.

An annular space 30 is formed between the inner periphery of the piston 26 and the outer periphery of the valve shank 18*a* and the face of the piston remote from the skirt 28 is provided at its inner periphery with an annular axially-extending projection 31 chamfered to a knife-edge. This face of the piston in combination with the seating ring 22 forms a relief valve and it is normally held in seating engagement with the relief valve seating ring 22 by the piston return spring 29 acting in one direction and by the inlet valve spring 24 acting in the opposite direction. When the piston 26 is abutting the end wall of the housing a small clearance 32 is left between the valve flange 21 and the sides and base of the frusto-conical cavity 3 in the housing and this clearance together with the bore of the outlet nozzle 4, the bore of the tubular inlet valve 18 and the larger bore 7 of the sleeve 5 form an operating chamber.

The housing is provided with a plurality of circumferentially spaced holes 33 which connect the relief chamber 20 with exhaust and a gauze filter covers the holes to prevent the ingress of foreign matter.

When the device is connected into a fluid-pressure system i.e. the inlet nozzle 10 to a source of pressure fluid and the outlet nozzle 4 to a mechanism to be operated, high pressure air flows through the passages 13 of the inlet portion into the high pressure portion and thence between the radial projections 9 to the tubular inlet valve 18. The air then passes through the tubular valve shank 18*a* to the outlet nozzle 4 and thence to the mechanism to be operated.

When the pressure in the outlet nozzle 4 and operating chamber attains a predetermined value it acts on the valve flange 21 and piston 26 to force the whole assembly towards the inlet end of the housing. The chamfered end of the tubular inlet valve 18 thus seats on the flat face 17 of the metal inlet valve seat 4 and the pressure is held within the device. However, if the pressure should increase beyond the desired value for any reason, e.g. a rise in temperature, the piston 26 will move further towards the inlet end of the housing and the knife edge 31 of the relief valve will leave its seating 22 thus allowing air to flow through the annular space 30 formed between the inner periphery of the piston and the outer periphery of the valve shank 18*a* into the relief chamber 30 and thence to atmosphere.

When the inlet valve 18 is seated on the metal inlet valve seat 14 there are no axial forces acting upon it tending to unseat it, therefore no compensating means are required and the valve will remain closed under the influence of its spring 24 until the pressure in the operating chamber drops to the desired value. As the pressure drops the piston moves back under the influence of the return spring 29 to close the relief valve and as the pressure drops still further the piston return spring 29 forces the piston and inlet valve flange 21 towards the outlet end of the housing thus opening the inlet valve to allow air to flow to the mechanism to be operated once more.

The use of metal and silicone-rubber seatings in the device hereinabove described renders it especially suitable for use with fluids at high temperatures. However, it is to be understood that the device may be provided with seatings of soft rubber or similar material in which case it would be suitable for use with fluids at ordinary temperatures.

What we claim is:—

1. A fluid pressure reducing device comprising a housing containing an operating chamber adapted to be connected at one end to a source of fluid pressure and at the other end to an apparatus to be operated and a relief chamber connected to exhaust, a rockably mounted inlet valve seat in the operating chamber, a tubular inlet valve slidable in a sleeve forming part of the operating chamber and spring urged towards the inlet valve seat, a relief valve seat carried by the tubular inlet valve at the end thereof remote from the inlet valve seat and a relief valve integral with a piston fluid-tightly slidable within the relief chamber, said relief valve being exposed on one face to the fluid pressure in the operating chamber and being spring loaded on the other face into engagement with the relief valve seat to close said valve and open the inlet valve whereby pressure fluid entering the inlet nozzle flows through the inlet valve and the operating chamber to the outlet nozzle and thence to the apparatus to be operated.

2. A fluid pressure reducing device according to claim 1 wherein the tubular inlet valve at the inlet valve seat end is chamfered to an annular knife-edge at the outer periphery thereof.

3. A fluid pressure reducing device according to claim 2 wherein said piston is annular and is co-axially aligned with said inlet valve.

4. A fluid pressure reducing valve according to claim 3 wherein the piston is provided with an axially-extending relief valve to co-operate with a relief valve seat carried by an annular flange at the outlet end of the tubular member, whereby relative movement between said piston and tubular member in one direction opens the relief valve and allows the passage of fluid through the piston from the operating chamber to the relief chamber.

5. A fluid pressure reducing device constructed and arranged substantially as described herein and as shown in the accompanying drawing.

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Agent for the Applicants.

PROVISIONAL SPECIFICATION

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This invention relates to fluid pressure reducing devices.

In the majority of known pressure reducing devices the pressure fluid exerts a substantial force on the associated inlet valve tending to hold it open and it is necessary to provide means to compensate for this force so that the device may be sensitive to fluctuations in pressure on the low pressure side.

It is an object of the invention to provide an improved pressure reducing device in which no substantial axial force is exerted by the pressure fluid tending to hold the movable portion of the device open and compensating means are therefore not required.

It is a further object of the invention to provide a pressure reducing device which incorporates an automatic relief valve of novel construction.

According to the invention a fluid pressure reducing device comprises a housing containing an operating chamber and a relief chamber, inlet and outlet nozzles for connecting the operating chamber to a source of pressure fluid and to an apparatus to be operated respectively, holes in said housing to connect the relief chamber with exhaust, an inlet valve seat in the operating chamber, a tubular inlet valve slidable in a sleeve forming part of the operating chamber and spring-urged towards the inlet valve seat, a relief valve seat carried by the inlet valve at the end remote from the inlet valve seat and a relief valve integral with a piston fluid-tightly slidable within the housing, said relief valve being exposed on one face to the fluid pressure in the operating chamber and being spring loaded on the other face into engagement with the relief valve seat to close said valve and open the inlet valve whereby pressure fluid entering the inlet nozzle flows through the inlet valve and the operating chamber to the outlet nozzle and thence to the apparatus to be operated.

In a preferred form of the invention the pressure reducing device contains a tubular inlet valve which has no axial forces acting upon it tending to open it when it is seated and an inlet valve seat which is self-aligning. The piston is annular and surrounds an intermediate portion of the tubular inlet valve, one face of the piston forming the relief valve and the other face of the piston providing means for locating a return spring. A cylindrical sleeve extends axially inwardly from the inlet end of the housing and serves as a guide for the inlet valve.

The pressure reducing device comprises a cylindrical housing open at the inlet valve end and having a reduced diameter portion at the outlet end. The exterior of this portion is threaded for connection to an apparatus to be

operated and forms an outlet nozzle and the interior is of frusto-conical shape, the portion of minimum diameter being nearest the outlet.

A high pressure portion comprising a cylindrical sleeve stepped to two diameters having a radially-extending flange formed integrally with the end of larger diameter is positioned within the housing. The bore of the flanged end is greater than the bore of the smaller end and a plurality of radial projections extend inwardly from the larger bore.

An inlet portion is screw-threaded at one end to form an inlet nozzle and is provided with a radially-extending flange at the other end. The flange abuts the flange of the high pressure portion and the two flanges are held tightly together and rigidly in contact with the open end of the housing by means of a ring nut screwed onto a threaded portion of the outer periphery of the housing. A plurality of passages inclined to the longitudinal axis of the inlet nozzle extend from the nozzle to the larger bore of the high pressure portion. A rockable and removable metal inlet valve seat of conical shape has a short stem extending into a recess formed between the passages of the inlet portion and a flat face located adjacent the radial projections said face being spaced a short distance from the ends of said projections to provide a clearance therebetween so that the valve seat can rock slightly within the operating chamber.

A tubular inlet valve is slidable through the smaller bore of the sleeve and has one end chamfered to a knife-edge adapted to seat on the flat face of the metal inlet valve seat. The valve has a tubular shank which extends axially through the housing to form an annular relief chamber between the inner periphery of the housing and the outer periphery of the valve shank. A radially-extending flange is formed integrally with the end of the valve shank remote from the chamfered end and is normally positioned within the frusto-conical cavity in the housing. A relief valve seating ring of silicone rubber is secured within an annular groove formed in the side of the valve flange remote from the outlet nozzle. The bore of the valve flange is countersunk to a depth approximately equal to half the thickness of the flange to form an annular radially-extending stem and a helical inlet valve spring is interposed between the step and an inwardly projecting abutment formed within the outlet nozzle. An annular piston provided with a metal sealing ring and having a cylindrical skirt is fluid-tightly slidable within the housing and is urged into contact with the end wall of the housing by means of a helical return spring positioned between the flange of the high pressure portion and the face of the piston adjacent the skirt.

An annular space is formed between the inner periphery of the piston and the outer periphery of the valve shank and the face of the piston remote from the skirt is provided at its inner periphery with an annular axially-extending projection chamfered to a knife-edge. This face of the piston forms a relief valve and it is normally held in seating engagement with the relief valve seating ring by the piston return spring acting in one direction and by the inlet valve spring acting in the opposite direction. When the piston is abutting the end wall of the housing a small clearance is left between the valve flange and the sides and base of the frusto-conical cavity in the housing and this clearance together with the bore of the outlet nozzle, the bore of the tubular inlet valve and the larger bore of the sleeve form an operating chamber.

The housing is provided with a plurality of circumferentially spaced holes which connect the relief chamber with exhaust and a gauze filter covers the holes to prevent the ingress of foreign matter.

When the device is connected into a fluid-pressure system i.e. the inlet nozzle to a source of pressure fluid and the outlet nozzle to a mechanism to be operated, high pressure air flows through the passages of the inlet portion into the high pressure portion and thence between the radial projections to the tubular inlet valve. The air then passes through the valve and tubular valve shank to the outlet nozzle and thence to the mechanism to be operated.

When the pressure in the outlet nozzle and operating chamber attains a pre-determined value it acts on the valve flange and piston to force the whole assembly towards the inlet end of the housing. The chamfered end of the inlet valve seats on the flat face of the metal inlet valve seat and the pressure is held within the device. However, if the pressure should increase beyond the desired value for any reason, e.g. a rise in temperature, the piston will move further towards the inlet end of the housing and the relief valve will leave its seating thus allowing air to flow through the annular space formed between the inner periphery of the piston and the outer periphery of the valve shank into the relief chamber and thence to atmosphere.

When the inlet valve is seated there are no axial forces acting upon it tending to unseat it, therefore no compensating means are required and the valve will remain closed under the influence of its spring until the pressure in the operating chamber drops to the desired value. As the pressure drops the piston moves back under the influence of the return spring to close the relief valve and as the pressure drops still further the piston return spring forces the piston and inlet valve flange towards the outlet end of the housing thus opening the inlet valve to allow air to flow to the mechanism to be operated once more.

The use of metal and silicone-rubber seatings in the device hereinabove described

renders it especially suitable for use with fluids at high temperatures. However, it is to be understood that the device may be provided with seatings of soft rubber or similar material in which case it would be suitable for use with fluids at ordinary temperatures.

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737,198 COMPLETE SPECIFICATION
1 SHEET

This drawing is a reproduction of the Original on a reduced scale.